



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

THE
AMERICAN NATURALIST.

VOL. XII. — NOVEMBER, 1878. — No. 11.

ASPIDIUM SPINULOSUM (SWARTZ) AND ITS VARIETIES.

BY GEO. E. DAVENPORT.

DURING several seasons past I have been making some special examinations of the different forms of *Aspidium spinulosum* as found growing in Middlesex county, Mass., and offer the result not as being decisive in character, but for the purpose of calling attention to the points involved, and inviting further investigations in the same direction.

An opinion prevails with many botanists that the large series of forms in this protean species so run into each other, and are oftentimes so confusing and difficult to place, that it would be better to ignore all of the so-called varieties and only recognize all forms under the one specific name. How far this opinion may or may not be correct, and founded on scientific principles, possibly this note may help to determine.

I certainly am not in favor of recognizing as a variety any form not possessing some well marked and permanent character to distinguish it from the recognized typical form of any species. I have so often expressed myself on this point that I do not feel under any apprehension of appearing inconsistent in endeavoring to show that the so-called var. *intermedium* is a good variety at least, if indeed it be not a good species.

The precise distinctions between *Aspidium spinulosum* Swz., and its var. *intermedium* have not as yet been clearly enough pointed out, so that the greatest confusion has prevailed in the effort to verify the presence here of true *spinulosum*, and to discover the differences between it and the variety; the usual assumption having been that nearly if not all of our American plants belonged to the latter form.

My own observations tend to convince me that Swartz's plant is by no means uncommon. Be that as it may, plants are found here abundantly enough that exactly conform to Swartz's description as given by him in his "Synopsis Filicum."

What then is *Aspidium spinulosum* Swz.? Swartz says of it, "Frondebis bipinnatis, pinnis pinnatifidis pinnatisque, laciniis oblongis acutis serrato-spinulosis, fronde ovato-triangularis; rachis glabra, stipite paleaceo." "Addenda et emendata," p. 419 to Synopsis Filicum, 1806. This describes in part nearly all of our American forms. Let us analyze the description and see:

1. *Fronds twice-pinnate.* This is true in many cases of *spinulosum*, and the varieties *dilatatum* and *intermedium*. In large and highly developed specimens of the two last forms the fronds are often thrice-pinnate, and usually appear to be more divided on account of the pinnules being more deeply cut; but the uncertain application of this character to any one particular form renders it unreliable as a specific character, or only of secondary importance.

2. *Pinnules pinnatifid, segments oblong, acute spinulose-toothed.* Common to all of the forms, and therefore as unreliable as the first character.

3. *Fronde triangular-ovate.* This more clearly belongs to the var. *dilatatum* than to any other form, although I have had specimens of *intermedium* that were broadly triangular in outline, and other things corresponding that form might be regarded as Swartz's plant for all there is in the description to the contrary, specimens being found commonly enough that are triangular-ovate in outline, bipinnate in structure, with smooth rachis and pale-brown scales.

4. *Rachis smooth.* This is the case with *spinulosum* and our *dilatatum*, but in *intermedium* the rachis is usually finely glandular. It will be necessary, however, to collect specimens early in order to observe this, as the rachis finally becomes smooth. This makes it difficult, if not impossible, to decide to which form Swartz's description was applied without knowing when, and in what state his plants were collected.

5. *Stipes clothed with pale brown scales.* This is the case, more or less, with all of our forms. The darker scales with blackish centers peculiar to the most highly developed forms are not reliable as a distinctive character.

From this it appears that in point of fact we have no *true spinulosum* as distinguished from other forms unless we choose to make it, and there would be no impropriety in calling it all *spinulosum*, as many are disposed to do, if we did not actually find in nature forms possessing characters sufficiently distinctive to justify recognition.

This being so we can only recognize as typical that form from which, in all probability, the others are most likely to have been derived, and to which, in connection with its special characters, Swartz's description may be best adapted.

Taking, now, the species as a whole, I find that it may be divided into two forms, one being glabrous beneath with perfectly smooth indusia, and the other being more or less finely glandular on the under surface with glandular indusia.

As there are many characters by which we can trace the glandular form to the smooth one, and show clearly enough that if it be not a good species it is at least a variation from that, we may by enlarging the significance of Swartz's "*rachis glabra*" so as to embrace the smooth indusia, safely assume that the smooth form is Swartz's plant.

But as this distinction is not clearly apparent after the contraction of the indusium in fruit, I have made examinations for the purpose of trying to find some other character by which we could determine specimens with equal certainty at all times; and this I have apparently found in the *position of the sori on the veins*.

Thus I find that in what I here recognize as true *spinulosum* the sori are placed on the *end of the veinlet*, which terminates *within the radius* of the fruit dot, while in the var. *intermedium* the sori are placed on the veinlet *below its apex*, so that it passes through and *beyond the radius* of the fruit dot.

This is a point of distinction between these two forms that has not been noticed heretofore by any one that I am aware of, and although I am not prepared to say that it is invariably the case, it has been so in all of the specimens that I have examined, the only apparent exception having been in the case of two or three imperfectly developed sori.

Let us briefly review and consider the importance of the principal characters of *spinulosum* and the var. *intermedium* as we actually find them in nature.

1. *As to color.* In characteristic specimens the typical form may be readily recognized by the peculiar shade of light-green that distinguishes it from the darker green of the variety. But as we soon find the former growing darker in color and blending with that of *intermedium*, especially as it approaches the so-called var. *dilatatum*, which as we have it in Eastern Massachusetts appears to be only a large, or higher developed state of *spinulosum*, we perceive that the color is not always to be depended upon as a specific character.

2. *As to form.* The terms ovate-lanceolate, oblong-lanceolate and triangular-ovate may be applied to particular fronds of either form, and therefore can only be considered in connection with a series of characters as a whole. In good specimens of what is here recognized as typical *spinulosum*, the fronds will vary from ovate-lanceolate to triangular-ovate. In ordinary forms the two lowest pair of pinnæ are about of an equal length and set obliquely on the rachis; the two or three pairs of pinnæ immediately above are longer, more spreading, though still retaining a somewhat oblique arrangement on the rachis, and give an abruptly dilated appearance to that part of the frond; above, the more or less obliquely-set pinnæ gradually decrease toward the apex, and this comes as near as possible to Swartz's description of "ovato-triangularis."

In characteristic specimens of *intermedium* the frond is usually oblong-lanceolate in outline, with decidedly spreading pinnæ that are not obliquely set on the rachis. But these two forms run together frequently in all sorts of ways, and can only be regarded as of secondary importance.

3. *As to structure.* In ordinary forms of *spinulosum* the fronds are only bipinnate, but this is equally true of the var. *intermedium*.

4. *As to the character of the scales.* This is too unreliable to be considered in any other way than in connection with the whole series of characters. The darker scales with blackish centers are found only on large and vigorous specimens of the var. *intermedium* and, but more rarely in this vicinity, var. *dilatatum*, but both of these forms frequently have pale brown scales like those on *spinulosum*.

5. *As to the character of the indusium.* In *spinulosum* the indu-

sia and under surface of the fronds are perfectly smooth, but in *intermedium* they are more or less glandular.

This character appears to be constant and, therefore, reliable, but it is necessary to collect specimens early in order to observe it, as the glands are fugaceous, quickly disappearing after the indusium begins to contract—a fact which accounts for the difficulty oftentimes experienced in properly placing specimens collected late.

6. *As to the position of the sori on the veins.* If this character proves constant it will be the most important one of all, as it will enable us to place specimens collected at any time with a greater degree of certainty, and, in connection with the character of the indusium, enable us to clear away much of the confusion surrounding the different forms of the species.

I sum up the relative value of the different characters as follows :

1. Color—not constant.
2. Scales—constant in ordinary forms of the species ; not constant in the varieties
3. Form—not constant.
4. Structure—not constant.
5. Character of the indusia—constant.
6. Position of the sori on the veins—constant.

It is too much to expect that any species or variety will exactly conform, in every instance, to any prescribed form or character, just as pieces of mechanism cast in dies by the hundred or thousand in unvarying conformity agree with one another ; and all we can do is to describe the general characters of a species or variety as we find them in nature.

A species often manifests itself in a great variety of forms, no two plants being exactly alike, and sometimes fronds on the same plant will exhibit surprising variation, so that it is exceedingly difficult to fix the limit and say which of the forms is typical, but as long as these forms can be referred to one common center of variation it does not seem well to recognize any such forms as varieties, and so we endeavor to describe as exactly as possible the character of that center of variation, and judge of all specimens by their relation to that.

When we find plants that cannot be referred to this first center of characters, but evidently proceed from another, if there are no

intermediate forms connecting the second center with the first, then the probabilities are in favor of the second plant being a distinct species; but if the second is directly connected with or related to the first by a graduating series of forms and other characters, then we are justified in regarding the second as a variety of the first, the intermediate forms being rather proofs of the fact than otherwise.

This is exactly the position in which I find *Aspidium spinulosum* and its var. *intermedium*.

As for the so-called var. *dilatatum*, as we have it in Eastern Massachusetts, I have not been able to discover any really good distinctive characters to justify regarding it as anything more than a highly developed state of *spinulosum*. Not only does the form of the fronds often agree with Swartz's description of the species, but frequently, even in very large specimens that appear at first sight more compound, they are only bipinnate in structure. I have so many times traced the ordinary form of the species step by step into our *dilatatum* that I have no faith in it as a variety, but think it should be embraced in the specific description. The smooth under surface and naked indusia clearly place it with the specific form, and in the specimens examined I have found the situation of the sori on the veins exactly the same as in the species.

On the other hand the more northern form, peculiar to the mountainous regions of New Hampshire and Vermont, is so different in appearance, being in every way larger and more compound, that it may be desirable to have some way of designating it, even though the characters are of secondary importance. For this reason it may be as well to retain the variety subject to this limitation.

Var. *Boottii*, I have always been inclined to regard as a distinct species on the supposition of its being a probable hybrid between *A. spinulosum* (*intermedium*) and *A. cristatum*, but if it is to be considered only as a variety, then it comes nearer to *cristatum* than it does to *spinulosum*. So far as my own and the observations of my friends extend, whenever it varies at all it recedes toward *cristatum*. Thus apparently indicating its origin. I have not yet met with a botanist who did not express some such feeling in regard to it.

The upper portion of the fertile frond certainly resembles the

var. *intermedium* in form, in the spinulose character of the pinnæ and the glandular indusia, but on the other hand the lower portion as strongly resembles *A. cristatum*, and it is still more closely connected with the latter species by the character of its sterile fronds. These so often resemble the sterile fronds of *A. cristatum* var. *Clintonianum*, that it is not always possible to separate them if they become mixed. Indeed, the resemblance between the larger forms of *Boottii* and ordinary forms of *Clintonianum* is sometimes so striking that it would be exceedingly difficult to distinguish them if it was not that in *Boottii* the indusiums are always covered with minute glands, while in *Clintonianum* they are perfectly smooth.

For these reasons I cannot subscribe to the opinion that its nearest affinity is with *spinulosum*, but favor removing it altogether from that species, and either placing it with *cristatum* or restoring it to its specific distinction.

But I will not undertake to decide this question here, the only object of the present paper being to give the results of my recent examinations, and to show, first, that we have good typical specimens of *A. spinulosum* in abundance, and second, that the var. *intermedium* possesses sufficiently good distinctive characters to justify our regarding it as a good variety, if not a species.

I submit the following (partial) descriptions of the two forms, intended only to cover the principal points in the present paper:

ASPIDIUM SPINULOSUM Swz. (*A. intermedium* Willd.)

1 to 3 feet high. Stipes clothed with pale or dark brown scales; fronds usually of a light (yellowish) green, sometimes dark, varying from ovate-lanceolate to triangular-ovate, twice or thrice pinnate; pinnæ arranged obliquely on the rachis, the lowest pairs unequally triangular-ovate or sub-deltoid, usually shorter and more oblique than those immediately above, lower pinnules often greatly elongated.

Under surface smooth; indusiums naked; sori terminal on the veins.

Medford, Mass., July, 1878.

ASPIDIUM SPINULOSUM var. *intermedium* Eaton. (*A. spinulosum* Willd.)

1 to 3 feet high. Scales of the stipes pale brown, or brown with darker centers; frond usually dark green, oblong-lanceolate, twice or thrice pinnate; pinnæ spreading, lower often unequally triangular-ovate with elongated lower pinnules.

Under surface finely glandular; indusiums covered with stalked glands; sori medial or sub-terminal on the veins.

NOTE.—In the foregoing paper I have not ventured to disturb the specific arrangement of the plants under consideration, but as the positions therein assumed may, if clearly established, render a re-arrangement necessary, I offer the following sugges-

tion as a basis for a re-arrangement of the different forms of *A. spinulosum* and *cristatum* :

1. ASPIDIUM SPINULOSUM Swz.

B. var. dilatatum Eaton, in Gray's Manual.—Embracing only the extreme northern form.

2. ASPIDIUM AMERICANUM. (*A. spinulosum* Willd., *A. spinulosum*, var. *intermedium* Eaton.)

I to 3 feet or more high; scales of the stipe pale or dark brown, often with darker centers, ovate or ovate-acuminate below, paler, narrowly lanceolate, and scattered along the main and secondary rachises above; frond ovate or oblong-lanceolate, twice or thrice pinnate; pinnæ spreading, lanceolate or ovate-lanceolate, acuminate, lower pair sometimes unequally triangular-ovate, with the lower pinnules elongated; pinnules oblong-ovate, acute, lower series longest, more or less incised, or cut clear to the rachis becoming again pinnate; lobes obliquely oblong, spinulosely toothed. Frond dark, often light green, stipe, rachises and veins sometimes purplish, *under surface minutely glandular, sori, medial, indusiums glandular.*

3. ASPIDIUM BOOTTII Tuckerman. *Aspidium spinulosum* var. *Boottii* Eaton, in Gray's Manual.

4. ASPIDIUM CRISTATUM Swz.

B. var. Clintonianum Eaton.

C. var. Floridanum Eaton.

I offer the following remarks on the above arrangement :

It is with considerable hesitation that I venture to recommend a new name for a fern so long known as a form of *A. spinulosum* under the name of *intermedium*, as I do not wish to appear to show any disposition to multiply species unnecessarily, or to disturb established and familiar names; but in reëstablishing the present form as a species there appears to be no alternative between doing this and adopting Willdenow's name of *A. intermedium*—a name heretofore improperly applied to our form. But that author's name does not belong here, for his description of *A. intermedium* does not contain a word in regard to the glandular indusiums and under surface, while, on the other hand, his description of *A. spinulosum* does, thus exactly reversing the usual arrangement.

For this reason we cannot write *A. intermedium* Willd., and as Swartz's name of *A. spinulosum* takes precedence and belongs to another form, we are also debarred from writing *A. spinulosum* Willd., thus leaving our plant without a name. Therefore we have no alternative but to provide a new one, and in selecting the present name I have taken into consideration the fact that our American form has always been regarded as peculiar to this continent, a fact which the present name definitely expresses.

The name itself has been used in part only, apparently to describe some form of *A. spinulosum* Sw. (*spinulosum-americanum* Fisch., MS., Index Fil. Moore, p. 104) but whether applied to the present form or to our American plants in general as the name implies, I have no means of knowing. Moore gives as a synonyme var. B. of *Lastrea dilatata*, a fern generally regarded as a distinct species by English authors.

But whatever may have been its application in that form, in bringing it forward here under the present combination, it becomes an entirely new and as much an original name as if it had never been used at all.

I have been led to restore *A. Boottii* to its specific value, and to retain Tuckerman's name for it from the following considerations:

The characters that seem to connect it with *cristatum* are, when more carefully examined, really no stronger than similar resemblances between other and good species.

For example, the sterile fronds of *A. munitum* of the Pacific States, and our northern *A. acrostichoides* are quite as much alike as the sterile fronds of *Boottii* and *cristatum*. Our common *A. marginale* and the Californian *A. argutum* sometimes so closely resemble each other as to suggest a closer relation than is accorded to them. These two species and *A. filix-mas* often appear to run together, having many similar resemblances, yet they are all three undoubtedly good species. Similar and equally strong resemblances may be found existing between many other species, and the puzzling forms of the small Botrychia are sufficient to show how little dependence can be placed, at times, on external appearances alone.

It is sometimes difficult to distinguish small specimens of *Cheilanthes lanuginosa* from *Notholana Parryi*, and not an uncommon thing for fronds of *Woodsia obtusa* and *Cystopteris fragilis* to become mixed through their close resemblance, and if this occurs among species belonging to entirely different genera, how much more likely is it to occur among closely related species. So that I cannot see why any argument drawn from such resemblances should have more weight in this instance than in those mentioned.

Few ferns are really more distinct than *A. Boottii*. Its individual character is even more pronounced than that of *A. inter-*

medium, and there is seldom any difficulty in distinguishing it at all times from all other ferns by which it may be surrounded. Its wide-spread distribution in this country and Europe (where it was first discovered and described as a species by Braun, under the name of *Aspidium remotum*, and where it seems to preserve its character no less distinctly than with us) entitles it to a higher consideration than that of a mere variety, and although its resemblances to *cristatum* are stronger than its resemblances to *spinulosum*, the glandular indusia keep it always distinct from the former species. In no instance known to me is there any record of glandular indusia occurring in *cristatum* while in *Boottii* they are always present.

Its anomalous character, however, occupying as it does an apparently intermediate position between *spinulosum* and *cristatum*, and the fact that it is generally found growing in company with those two species, has led many to regard it as a probable hybrid, but a proper consideration of this theory will show that while it may be possible for those two species to hybridize as frequently as this theory would pre-suppose, it is hardly probable that they should do so in so many instances, and under such widely different circumstances and surroundings without producing some other than this one particular form, everywhere so uniform in its character. But even this theory, if established, would only result in raising our plant to the dignity of a species, a position to which I think it no less entitled now.

I retain Tuckerman's name, as it is the only one by which our plant is generally known to American botanists, and having been used frequently abroad, it has the additional merit of being the best known and most widely used of all names.

Finally, if it be urged against my paper that, as my investigations have apparently been limited to Middlesex County, they can only be regarded as partial, I answer that those observations were made upon living plants growing in their natural situations, and other examinations of a series of herbarium specimens from Maine, Vermont, Massachusetts, New York and other States, have only strengthened my convictions in regard to them.

During a recent visit to Portland, Me., I visited a number of rich swamps in the neighboring towns and found *A. americanum* to be the prevailing form in that vicinity. I met with *A. spinulosum* but twice, and in both instances the specimens were well marked and characteristic.

Some of the specimens of *A. americanum* were remarkably large and fine, and might have been mistaken for *dilatatum*—with which form large specimens are no doubt often confounded—but a close examination revealed all of the characters that I have described as belonging to this species.

—:O:—

PLASTER OF PARIS AS AN INJECTING MASS.¹

BY SIMON H. GAGE, B.S.

THE necessity for some artificial, colored medium to fill the blood vessels must have been felt by the first anatomists. Indeed, injections were rudely made by Eustachius and Varolius in the sixteenth century (Turner, 1, I, 812).²

It was left, however, to De Graaf and Swammerdam to fairly initiate the process in the middle of the seventeenth century (Turner, 1, I, 812).

De Graaf used mercury and colored fluids, and was the inventor of the injecting syringe (2, XVII, 291); but it is to Swammerdam that anatomists owe most, for he introduced the use of colored wax (2, XL, 477 and 1, I, 812). This answers fairly the requirements of an injecting mass, as it may be used in the fluid state, but becomes solid very soon afterward. Upon renouncing anatomy for mysticism, Swammerdam gave his secret to Ruysch, his fellow countryman (2, XL, 477), who perfected the art, and fairly approached in skill and excellence of results the refinements of modern anatomy (1, I, 812, and 2, XXXVII, 143).

About the middle of the eighteenth century, Monro *primus* published an essay on anatomical injections (4), in which were given very precise directions for the manipulation and preparation of the injecting mass. It was composed of wax, tallow, oil and turpentine, colored with vermilion, verdigris or lamp-black (3).

In the latest works which treat of the technology of injections (5, 6 and 7), nearly the same formulæ for injecting masses are given; and except a mere mention of gypsum in Martin (7, II, 99), all coarse masses are solid at ordinary temperatures and must

¹ This paper is based upon investigations made in course of the preparation of a Manual for the Dissection of Cats, by Prof. Burt G. Wilder and the writer.

² See list of works referred to at the end of this paper. The first figure designates the number on the list; the last, the page; the middle, Roman numeral, the volume.